

04-07-00

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JC784 U.S. PTO
04/05/00

005179

PATENT TRADEMARK OFFICE

PATENT

Preliminary classification:
Proposed Class:
Subclass:

NOTE: All applicants are requested to include a preliminary classification on newly filed patent applications. The preliminary classification, preferable class and subclass designations, should be identified in the upper right-hand corner of the letter of transmittal accompanying the application papers, for example >Proposed Class 2, subclass 129, M.P.E.P § 601, 7th ed.

Box: Patent Application
Director of the U.S. Patent
and Trademark Office
Washington, D.C. 20231

JC784 U.S. PTO
04/05/00
229345/60

Practitioner Docket No. SD-6358

NEW APPLICATION TRANSMITTAL

Transmitted herewith for filing is the patent application of
Inventor(s):

RICHARD B. DIVER, JR., JAMES W. GROSSMAN and MICHAEL RESHETNIK

WARNING:

37 CFR 1.41(a) (1) points out:

"(a) A patent is applied for in the name or names of the actual inventor or inventors.

"(1) The inventorship of a nonprovisional application is that inventorship set forth in the oath or declaration as prescribed by § 1.63, except as provided for in § 1.53(d)(4) and § 1.63(d). If an oath or declaration as prescribed by § 1.63 is not filed during the pendency of a nonprovisional application, the inventorship is that inventorship set forth in the application papers filed pursuant to § 1.53(b) unless a petition under this paragraph accompanied by the fee set forth in § 1.17(l) is filed supplying or changing the name or names of the inventor or inventors."

For (title):

SOLAR REFLECTION PANELS

CERTIFICATION UNDER 37 CFR 1.10*
(Express Mail label number is **mandatory**.)
(Express Mail certification is optional.)

I hereby certify that this New Application Transmittal and the documents referred to as enclosed therein are being deposited with the United States Postal Service on this date, April 5, 2000, in an envelope as "Express Mail Post Office to Addressee" Mailing Label No. EL368198049US addressed to the: Box: PATENT APPLICATIONS, Director of the U.S. Patent and Trademark Office, Washington, D.C. 20231.

Annette M. Turk, Legal Assistant

(Signature of person mailing paper)

NOTE: Certificate of mailing (first class) or facsimile transmission procedures of 37 CFR 1.8 cannot be used to obtain a date of mailing or transmission for this correspondence.

NOTE: Each paper or fee referred to as enclosed herein **must** have the number of the "Express Mail" mailing label placed thereon prior to mailing. 37 CFR 1.10(b).

"Since the filing of correspondence under § 1.10 without the Express Mail Mailing label thereon is an oversight that can be avoided by the exercise of reasonable care, requests for waiver of this requirement will **not** be granted on petition," Notice of Oct. 24, 1996, 60 Fed. Reg. 56,439 at 56,442.

1. Type of Application

This new application is for a(n) (check one applicable item below):

- ☒ Original (Nonprovisional)
☐ Design
☐ Plant

WARNING: Do not use this transmittal for a completion in the U.S. of an International Application under 35 U.S.C. 371(c)(4) unless the international Application is being filed as a divisional, continuation or continuation-in-part application.

WARNING: Do not use this transmittal for the filing of a provisional application.

NOTE: If one of the following 3 items apply then complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF A PRIOR U.S. APPLICATION IS CLAIMED and a NOTIFICATION IN PARENT APPLICATION OF THE FILING OF THIS CONTINUATION APPLICATION

- ☐ Divisional
☐ Continuation
☐ Continuation-in-part (C-I-P)

2. Benefit of Prior U.S. Application(s) (35 USC 119(e), 120 or 121)

Note: A nonprovisional application may claim an invention disclosed in one or more prior filed copending nonprovisional applications or copending international applications designating the United States of America. In order for a nonprovisional application to claim the benefit of a prior filed copending nonprovisional application or copending international application designating the United States of America, each prior application must name as an inventor at least one inventor named in the later filed nonprovisional application and disclose the named inventor's invention claimed in at least one claim of the later filed nonprovisional application in the manner provided by the first paragraph of 35 U.S.C. 112. Each prior application must also be:

- (i) An international application entitled to a filing date in accordance with PCT Article 11 and designating the United States of America; or
 - (ii) Complete as set forth in § 1.51(b); or
 - (iii) Entitled to a filing date as set forth in § 1.53(b) or § 1.53(d) and include the basic filing fee set forth in § 1.16; or
 - (iv) entitled to a filing date as set forth in § 1.53(b) and have paid therein the processing and retention fee set forth in § 1.21(l) within the same period set forth in § 1.53(f).
- 37 C.F.R. § 1.78(a)(1).

NOTE: If the new application being transmitted is a divisional, continuation or a continuation-in-part of a parent case, or where the parent case is an International Application which designated the U.S., or benefit of a prior provisional application is claimed, then check the following item and complete and attach ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

WARNING: If an application claims the benefit of the filing date of an earlier filed application under 35 USC 120, 121 or 365(c), the 20-year term of that application will be based upon the filing date of the earliest U.S. application that the application makes reference to under 35 USC 120, 121 or 365(c), (35 USC 154(a)(2) does not take into account, for the determination of the patent term, any application to which priority is claimed under 35 USC 119, 365(a) or 365(b).) For a C-I-P application, applicant should review whether any claim in the patent that will issue is supported by an earlier application and, if not, the applicant should consider canceling the reference to the earlier filed application. The term of a patent is not based on a claim-by-claim approach. See Notice of April 14, 1995, 60 Fed. Reg. 20, 195, at 20,205

WARNING: When the last day of pendency of a provisional application falls on a Saturday, Sunday, or Federal holiday within the District of Columbia, any nonprovisional application claiming benefit of the provisional application **must** be filed prior to the Saturday, Sunday, or Federal holiday within the District of Columbia. See 37 C.F.R. § 1.78(a)(3)

- The new application being transmitted claims the benefit of prior U.S. application(s) and enclosed are **ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.**

3. Papers Enclosed

A. Required For Filing Date Under 37 CFR 1.53(b) (Regular) or 37 CFR 1.153 (Design) Application

12 Pages of specification

4 Pages of claims

1 Sheets of Drawing

WARNING: DO NOT submit original drawings. A high quality copy of the drawings should be supplied when filing a patent application. The drawings that are submitted to the Office must be on strong, white, smooth, and non-shiny paper and meet the standards according to § 1.84. If corrections to the drawings are necessary, they should be made to the original drawing and a high-quality copy of the corrected original drawing then submitted to the Office. **Only one copy is required or desired.** For comments on proposed new 37 CFR 1.84. Notice of March 9, 1988 (1990 O.G. 57-62).

NOTE: "Identifying indicia, if provided, should include the application number or title of the invention, inventor's name, docket number, and the name and phone number of a person to call if the Office is unable to match the drawings to the proper application. This information should be placed on the back of each sheet of drawing a minimum distance of 1.5 cm. (5/8") down from the top of the page." 37 CFR 1.84(c).

(complete the following, if applicable)

— The enclosed drawing(s) are photograph(s), and there is also attached a "PETITION TO ACCEPT PHOTOGRAPH(S) AS DRAWINGS(S)". 37 CFR 1.84(b).

— formal

X informal

B. Other Papers Enclosed

7 Pages of declaration and power

1 Pages of Abstract

— Other

4. Additional papers enclosed

— Amendment to claims

— Cancel in this application claims _____ before calculating the filing fee. (at least one original independent claim must be retained for filing purposes.)

— Add the claims shown on the attached amendment. (claims added have been numbered consecutively following the highest numbered original claim.)

— Preliminary Amendment

X Information Disclosure Statement (37 CFR 1.98)

X Form PTO-1449 (PTO/SB/08A and 08/B)

X Citations

— Declaration of Biological Deposit

— Submission of "Sequence Listing," computer readable copy and/or amendment pertaining thereto for biotechnology invention containing nucleotide and/or amino acid sequence.

— Authorization of Attorney(s) to Accept and Follow Instructions from Representative

— Special Comments

X Other X Associate Power of Attorney

— Petition to Make Special

5. Declaration or oath (including power of attorney)

NOTE: A newly executed declaration is not required in a continuation or divisional application provided that the prior nonprovisional application contained a declaration as required, the application being filed is by all or fewer than all the inventors named in the prior application, there is no new matter in the application being filed, and a copy of the executed declaration filed in the prior application (showing the signature or an indication thereon that it was signed) is submitted. The copy must be accompanied by a statement requesting deletion of the names of person(s) who are not inventors of the application being filed. If the declaration in the prior application was filed under § 1.47, then a copy of that declaration must be filed accompanied by a copy of the decision granting § 1.47 status or, if a nonsigning person under § 1.47 has subsequently joined in a prior application, then a copy of the subsequently executed declaration must be filed. See 37 C.F.R. § 163(d)(1)-(3).

Note: A declaration filed to complete an application must be executed, identify the specification to which it is directed, identify each inventor by full name including family name and at least one given name, without abbreviation together with any other given name or initial, and the residence, post office address and country or citizenship of each inventor, and state whether the inventor is a sole or joint inventor. 37 C.F.R. § 1.63(a)(1)-(4).

Note: "The inventorship of a nonprovisional application is that inventorship set forth in the oath or declaration as prescribed by § 1.62, except as provided in § 1.53(d)(4) and § 1.63(d). If an oath or declaration as prescribed by § 1.63 is not filed during the pendency of a nonprovisional application, the inventorship is that inventorship set forth in the application papers filed pursuant to § 1.53(b), unless a petition under this paragraph accompanied by the fee set forth in § 1.17(i) is filed supplying or changing the name or names of the inventor or inventors." 37 C.F.R. § 1.41(a)(1).

☒ Enclosed **UNSIGNED**

executed by (check **all** applicable boxes)

☒ inventor(s).

☐ legal representative of inventor(s) 37 CFR 1.42 or 1.43

☐ joint inventor or person showing a proprietary interest on behalf of inventor who refused to sign or cannot be reached

☐ This is the petition required by 37 CFR 1.47 and the statement required by 37 CFR 1.47 is also attached. See item 13 below for fee.

☐ Not enclosed

WARNING: Where the filing is a completion in the U.S. of an International Application but where a declaration is not available or where the completion of the U.S. application contains subject matter in addition to the International Application the application may be treated as a continuation or continuation-in-part, as the case may be, utilizing **ADDED PAGE FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION CLAIMED.**

☐ Application is made by a person authorized under 37 CFR 1.41(c) on behalf of all the above named inventor(s).

(The declaration or oath, along with the surcharge required by 37 CFR 1.16(e) can be filed subsequently.)

☐ Showing that the filing is authorized. (Not required unless called into question. 37 CFR 1.41(d).

6. Inventorship Statement

NOTE: If the named inventors are each not the inventors of all the claims an explanation, including the ownership of the various claims at the time the last claimed invention was made, should be submitted

The inventorship for all the claims in this application are:

☐ The same

or

☐ Are not the same. An explanation, including the ownership of the various claims at the time the last claimed invention was made,

☐ is submitted

☐ will be submitted.

7. Language

NOTE: An application including a signed oath or declaration may be filed in a language other than English. A verified English translation of the non-English language application and the processing fee of \$130.00 required by 37 CFR 1.17(k) is required to be filed with the application or within such time as may be set by the Office. 37 CFR 1.52(d).

NOTE: A non-English oath or declaration in the form provided or approved by the PTO need not be translated. 37 CFR 1.69(b).

☒ English

☐ non-English

☐ the attached translation includes a statement that the translation is accurate.
37 CFR 1.52(d).

8. Assignment

☐ An assignment of the invention to _____.

☐ is attached. A separate _____ "COVER SHEET FOR ASSIGNMENT DOCUMENT) ACCOMPANYING NEW PATENT APPLICATION" or _____ FORM PTO 1595 is also attached.

☐ will follow.

NOTE: "If an assignment is submitted with a new application, send two separate letters -- one for the application and one for the assignment." Notice of May 4, 1990 (1114 O.G. 77-78).

WARNING: A newly executed "CERTIFICATE UNDER 37 CFR 3.73(b)" must be filed when a continuation-in-part application is filed by an assignee. Notice of April 30, 1993, 1150 O.G. 62-64.

9. Certified Copy

Certified copy(ies) of application(s)

(country)	(appln.no.)	(filed)
(country)	(appln.no.)	(filed)
(country)	(appln.no.)	(filed)

from which priority is claimed.

☐ is (are) attached.

☐ will follow.

NOTE: The foreign application forming the basis for the claim for priority **must** be referred to in the **oath or declaration**. 37 CFR 1.55(a) and 1.63.

NOTE: This item is for any foreign priority for which the application being filed directly relates. If any parent U.S. application or International Application from which this application claims benefit under 35 U.S.C. 120 is itself entitled to priority from a prior foreign application then complete item 18 on the ADDED PAGES FOR NEW APPLICATION TRANSMITTAL WHERE BENEFIT OF PRIOR U.S. APPLICATION(S) CLAIMED.

10. Fee Calculation (37 CFR 1.16)

A. ☒ Regular application

CLAIMS AS FILED					
Number Filed		Number Extra	Rate	Basic Fee 37 CFR 1.16(a) \$690.00	
Total Claims 37 CFR 1.16(c)	29 - 20 =	9	X \$18.00	162.00	
Independent Claims 37 CFR 1.16(b)	3 - 3 =	0	X \$78.00		
Multiple dependent claim(s), if any 37 CFR 1.16(d)			X \$260.	0.00	

☐ Amendment canceling extra claims enclosed.

- ☐ Amendment deleting multiple-dependencies enclosed.
☐ Fee for extra claims is not being paid at this time.

NOTE: If the fees for extra claims are not paid on filing they must be paid or the claims canceled by amendment prior to the expiration of the time period set for response by the Patent and Trademark Office in any notice of fee deficiency. 37 CFR 1.16(d).

Filing Fee Calculation \$ 852.00

B. ☐ **Design Application**
 (\$310.00 -- 37 CFR 1.16(f)) \$ 310.00

C. ☐ **Plant Application**
 (\$480.00 -- 37 CFR 1.16(g)) \$ 480.00

Filing Fee Calculation \$

11. Small Entity Statement(s)

- ☐ Statement(s) that this is a filing by a small entity under 37 CFR 1.9 and 1.27 is (are) attached

WARNING: "Status as a small entity must be specifically established in each application or patent in which the status is available and desired. Status as a small entity in one application or patent does not affect any other application or patent, including applications or patents which are directly or indirectly dependent upon the application or patent in which the status has been established. The refiling of an application under § 1.53 as a continuation, division, or continuation-in-part (including a continued prosecution application under § 1.53(d), or the filing of a reissue application requires a new determination as to continued entitlement to small entity status for the continuing or reissue application. A nonprovisional application claiming benefit under 35 USC 119(e), 120, 121 or 365(c) of a prior application or a reissue application may rely on a statement filed in the prior application or in the patent if the nonprovisional application or the reissue application includes a reference to a statement in the prior application or in the patent or includes a copy of the statement in the prior application or in the patent and status as a small entity is still proper and desired. The payment of the small entity basic statutory filing fee will be treated as such a reference for purposes of this section" 37 CFR § 1.28(a).

"Small entity status must not be established with the person or persons signing the...statement can unequivocally make the required self-certification." M.P.E.P. § 509.03, 6th ed., rev. 2, July 1996 (emphasis added).

(complete the following, if applicable)

- ☐ Status as a small entity was claimed in prior application U.S. Serial No. _____ filed on _____ from which benefit is being claimed for this application under:

35 USC ☐ 119(e)
☐ 120
☐ 121
☐ 365(c),

and which status as a small entity is still proper and desired.

- ☐ A copy of the Statement in the prior application is included.

Filing Fee Calculation (50% of A, B, or C above) \$

NOTE: Any excess of the full fee paid will be refunded if a statement and a refund request are filed within two months of the date of timely payment of a full fee. 37 CFR 1.28(a). The two-month period is not extendable under § 1.136. 37 CFR 1.28(a)

12. Request for International-Type Search (37 CFR 1.104(d)) (complete if applicable)

- ☐ Please prepare an international-type search report for this application at the time when national examination on the merits takes place.

13. Fee Payment Being Made At This Time

☐ Not Enclosed
☐ No filing fee is to be paid at this time. (This and the surcharge required by 37 CFR 1.16(e) can be paid subsequently.)

☒ Enclosed
☒ basic filing fee \$ 852.00

☐ recording assignment (\$40.00; 37 CFR 1.21(h)) \$ _____
[see attached COVER SHEET FOR ASSIGNMENT
ACCOMPANYING NEW APPLICATION]

☐ petition fee for filing by other than all the inventors
or person on behalf of the inventor where inventor
refused to sign or cannot be reached (\$130.00; 37
CFR 1.47 and 1.17(i)) \$ _____

☐ for processing an application with a specification in
a non-English language (\$130.00; 37 CFR 1.52(d)
and 1.17(k)) \$ _____

☐ processing and retention fee
(\$130.00; 37 CFR 1.52(d) and 1.21(l)) \$ _____

☐ fee for international-type search report \$40.00; 37
CFR 1.21(e)) \$ _____

NOTE: 37 CFR 1.21(l) establishes a fee for processing and retaining any application which is abandoned for failing to complete the application pursuant to 37 CFR 1.53(f) and this, as well as the changes to 37 CFR 1.53 and 1.78 (a)(1), indicate that in order to obtain the benefit of a prior U.S. application, either the basic filing fee must be paid or the processing and retention fee of § 1.21(l) must be paid within 1 year from notification under § 53(f).

Total fees enclosed \$ 852.00

14. Method of Payment of Fees

☒ Check(s) in the amount of \$ 852.00
☐ Charge Account No. 13-4213 in the amount of \$ _____. A duplicate of this transmittal is attached.

NOTE: Fees should be itemized in such a manner that it is clear for which purpose the fees are paid. 37 CFR 1.22(b).

15. Authorization to Charge Additional Fees

WARNING: If no fees are to be paid on filing the following items should **not** be completed.

WARNING: Accurately count claims, especially multiple dependent claims, to avoid unexpected high charges, if extra claim charges are authorized.

X The Commissioner is hereby authorized to charge the following additional fees by this paper and during the entire pendency of this application to Account No. 13-4213:

X 37 CFR 1.16(a), (f) or (g) (filing fees)

X 37 CFR 1.16(b), (c) and (d) (presentation of extra claims)

NOTE: Because additional fees for excess or multiple dependent claims not paid on filing or on later presentation must only be paid or these claims canceled by amendment prior to the expiration of the time period set for response by the PTO in any notice of fee deficiency (37 CFR 1.16(d)), it might be best not to authorize the PTO to charge additional claim fees, except possibly when dealing with amendments after final action.

X 37 CFR 1.16(e) (surcharge for filing the basic filing fee and/or declaration on a date later than the filing date of the application)

X 37 CFR 1.17(a)(1)-(5) (application processing fees)

NOTE: "...A written request may be submitted in an application that is an authorization to treat any concurrent or future reply, requiring a petition for an extension of time under this paragraph for its timely submission, as incorporating a petition for extension of time for the appropriate length of time. An authorization to charge all required fees, fees under § 1.17, or all required extension of time fees will be treated as a constructive petition for an extension of time in any concurrent or future reply requiring a petition for an extension of time under this paragraph for its timely submission. Submission of the fee set forth in § 1.17(a) will also be treated as a constructive petition for an extension of time in any concurrent reply requiring a petition for an extension of time under this paragraph for its timely submission." 37 C.F.R. § 1.136(a)(3).

 37 CFR 1.18 (issue fee at or before mailing of Notice of Allowance, pursuant to 37 CFR 1.311(b)).

NOTE: Where an authorization to charge the issue fee to a deposit account has been filed before the mailing of a Notice of Allowance, the issue fee will be automatically charged to the deposit account at the time of mailing the notice of allowance. 37 CFR 1.311(b).

NOTE: 37 CFR 1.28(b) requires "Notification of any change in loss of entitlement to small entity status must be filed in the application . . . prior to paying, or at the time of paying . . . issue fee." From the wording of 37 CFR 1.28(b): (a) notification of change of status must be made even if the fee is paid as "other than a small entity" and (b) no notification is required if the change is to another small entity.

16. Instructions As To Overpayment


Note: "...amounts of twenty-five dollars or less will not be returned unless specifically requested within a reasonable time, nor will the payor be notified of such amounts; amounts over twenty-five dollars may be returned by check or, if requested, by credit to a deposit account." 37 C.F.R. § 1.26(a).

X credit Account No. 13-4213
 refund

Reg. No. 35,964

Tel. No. (505) 998-1500

Customer No. 005179


Jeffrey D. Myers
PEACOCK, MYERS & ADAMS, P.C.
P. O. Box 26927
Albuquerque, New Mexico 87125-6927
Direct line: (505) 998-1502

[illegible]

____ Plus Added Pages for New Application Transmittal Where Benefit of Prior U.S.
Application(s) Claimed Number of pages added ____

Plus added pages deleting names of inventor(s) named in prior application(s) who is/are no longer inventor(s) of the subject matter claimed in this application
Number of pages added _____

Statement Where No Further Pages Added

This transmittal ends with this page.

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PATENT APPLICATION

SOLAR REFLECTION PANELS

GOVERNMENT RIGHTS

5

The Government has rights to this invention pursuant to Contract No. DE-AC04-94AL85000 awarded by the U.S. Department of Energy.

BACKGROUND OF THE INVENTION

Field of the Invention (Technical Field):

The present invention relates to solar collector panels and the methods of making the same.

Background Art:

Low-cost/high-performance solar collectors are needed to make solar thermal power competitive with other power sources. Incorporation of mirrors into commercially viable panels is the key to low-cost, high-performance solar collectors. In the 1970's and 1980's and with the financial support of the U. S. government, substantial development and test activities were directed toward the development of glass reflector designs for central receiver heliostats, parabolic trough collectors, and point focus concentrators ("solar collectors"). However, many problems surfaced with a majority of the solar collectors, such as the formation of dimples due to adhesion forces exerted on the glass, and the seepage of water between the bonded mirror and support resulting in silver corrosion of the mirror and consequent loss of solar reflectivity.

Glass-foam core mirrors were developed by the Jet Propulsion Laboratory (JPL). At JPL glass mirrors were mechanically deformed and bonded to a foamed glass support that had been ground to a specified contour. To minimize debonding of the glass mirror to the support, materials with similar thermal expansion coefficients were used. Argoud, M.J., 1980, "Test Bed Concentrator Mirrors,"

Proceedings of the First Semiannual Distributed Receiver Systems Program Review, DOE/JPL-1060-33, Pasadena, CA. Steel-substrate supports were used in the McDonnell Douglas dish concentrator. Stone, K.W. et al., 1993, "Status of Glass Reflector Technology for Heliostats and Concentrators," Proceedings of the 28th Intersociety Energy Conversion Engineering Conference, Atlanta, GA. This design entailed bonding glass mirrors to a steel sheet, which in turn was supported by a stretch-formed or stamped steel backup structure (like the support found in a car hood). A similar type of support, but with rib supports stretch-formed or stamped to the desired curvature, were used by Acurex in their Innovative Concentrator design and by Solar Kinetics, Inc. (SKI) on the Shenandoah dishes. However, both the Accurex and the Solar Kinetics concentrators used reflective film technology rather than glass mirrors. Overly, et al., 1985, "Innovative Point Focus Solar Design, Task 1, 2a, Topical Report," DOE-AL/23711-1, Albuquerque, NM., and Saydah et al., 1983, "Final Report on Test of STEP Shenandoah Parabolic Dish Solar Collector Quadrant Facility," SAND82-7153, Sandia National Laboratories, Albuquerque, NM. Lastly, fiberglass supports formed over a mandrel have been investigated by Kansas Structural (Gill, S.R., Plunkett, J.D., 1997, "Fabrication of Four Focusing Solar Collector Segments of Widely Differing Geometries From Fiber-Reinforced Polymer Honeycomb Composite Panels," Final Report Submitted to Sandia National Laboratories, Albuquerque, NM.) and McDonnell Douglas (NREL Final Report, 1998, "Solar Thermal Component Manufacturing for Near-Term Markets," Subcontract ZAP-5-15299-02, Golden, CO.)

Some of most promising early efforts to develop solar collector mirror panels used sandwich-type construction. In sandwich-type construction, membranes, such as sheet steel, aluminum, or plastic, are bonded to both sides of a core material. This type of construction is widely utilized in products ranging from doors and tables to aircraft and boats and is characterized by high strength-to-weight ratios. In the case of solar collectors, glass mirrors are adhesively bonded to one of the membranes. Examples of sandwich construction mirrors include the Solar One heliostat mirrors (Stone, et al., 1993), the Solar Kinetics, Inc. Innovative Concentrator Panels (Schertz, P.T., 1986, "Design of a Point-Focus

Concentrator," Proceedings of the Solar Thermal Technology Conference, Diver, R.B. (ed.), SAND86-0536, Sandia National Laboratories, Albuquerque, NM.), the General Electric Parabolic Dish Concentrator (the PDC-1 used a reflective film) (Sobczak, I.F., Pons, R.L., Thostesen, T., 1982, "Development Status of The PDC-1 Parabolic Dish Concentrator," Parabolic Dish Solar Thermal Power Annual Program Review Proceedings, DOE/JPL-1060-52, Pasadena, CA.), and the Cummins Utility-Scale dish concentrator. Some of the early prototype trough mirrors also used sandwich-type construction mirrors.

Recently, stretched-membrane designs incorporating membranes of plastic or steel stretched over both sides of a ring have received a lot of attention. In the stretched membrane design, vacuum in the plenum between the membranes is used to create the required curvature. Examples include LaJet/Cummins panels, the SAIC USJVP dish and several heliostat designs. Bean, J.R., Diver, R.B., 1995, "Technical Status of the Dish/Stirling Joint Venture Program," Proceedings of the 30th Intersociety Energy Conversion Engineering Conference, Paper Number 95-202, Orlando, FL.; Beninga, K., Butler, B., Sandubrae, J., Walcott, K., 1989, "An Improved Design for Stretched-Membrane Heliostats," SAND89-7027, Albuquerque, NM; and Beninga, K., Davenport, R.L., Sellars, J.A., Smith, D., Johansson, S., 1997, "Performance Results for the SAIC/STM Prototype Dish/Stirling System," Proceedings of the 1997 ASME International Solar Energy Conference, Washington, D.C. Stretched-membrane solar collectors with plastically deformed metal membranes have been developed by Solar Kinetics, Inc. Schertz P. E., P. T., Brown, D. C. Konnerth III, A., 1991, "Facet Development for a Faceted Stretched-Membrane Dish by Solar Kinetics, Inc.," SAND91-7009, Sandia National Laboratories, Albuquerque, NM; and Schlaich, J., Bergemann, R., Schiel, W., 1994, "Solar Stretch," *Civil Engineering*.

In spite of the considerable activity put toward the development of solar collectors, there remains the need for a cost effective, solar collector that is durable and has good optical properties.

SUMMARY OF THE INVENTION (DISCLOSURE OF THE INVENTION)

The present invention is a solar collector comprising a glass mirror and a composite panel, wherein the back of said mirror is affixed to a front surface of the composite panel. The composite panel comprises a front sheet affixed to a surface of a core material, preferably a core material comprising a honeycomb structure, and a back sheet affixed to an opposite surface of the core material. The invention may further comprise a sealing strip, preferably comprising EPDM, positioned between the glass mirror and the front surface of the composite panel. In the preferred embodiment, the glass mirror comprises a silvered backing and the front sheet and back sheet comprise carbon steel of approximately 24 gauge. Also, the honeycomb core material comprises aluminum preferably constructed from approximately 0.015 and 0.004 inch aluminum foil. In alternative embodiments, the core material comprises foam selected from the group consisting of polystyrene, polyurethane, and polyvinyl chloride, or a cellulose based material.

The invention is also of a method of making a solar collector comprising the following steps: affixing a glass mirror, preferably a glass mirror comprising a silvered backing, to a front sheet to make a glass/sheet laminate; affixing the sheet side of the laminate to a surface of a core material; affixing a back sheet to an opposite surface of the core material to make a composite panel; and shaping the composite panel to a specific curvature by curing the composite panel over a mandrel of approximately inverse curvature. The invention may further comprise the step of positioning a sealing strip, preferably a sealing strip comprising EPDM, between the glass mirror and front sheet to minimize the accumulation of moisture between the glass mirror and front sheet. The preferred method of producing multiple solar collectors comprises stacking a plurality of the composite panels atop a single mandrel. A vacuum is then applied to the composite panel in contact with the mandrel.

An alternative method of making a solar collector comprises the following steps: affixing a glass mirror, preferably a glass mirror comprising a silvered backing, to a front sheet to make a glass/sheet

lamine; placing the glass/sheet laminate mirror side down over a mandrel of specific curvature; applying a coating expandable foam, preferably an expandable foam selected from the group consisting of polystyrene, polyurethane, and polyvinyl chloride, on the sheet side of the laminate; positioning a back sheet in a frame such that as the foam expands the foam comes in contact with a surface of the back sheet and forces the composite panel to adopt the inverse shape of the mandrel; and removing the frame from the back sheet and the composite panel from the mandrel.

A primary object of the present invention is to provide a solar collector constructed from low cost materials and with low cost manufacturing procedures.

Another object of the invention is to provide a solar collector that is durable to environmental stresses such that the desired optical properties are maintained over many years.

A primary advantage of the present invention is the relative low cost materials used to construct the solar collector.

Another advantage of the present invention is the relative low cost manufacturing process used to construct the solar collector.

Other objects, advantages and novel features, and further scope of applicability of the present invention will be set forth in part in the detailed description to follow, taken in conjunction with the accompanying drawings, and in part will become apparent to those skilled in the art upon examination of the following, or may be learned by practice of the invention. The objects and advantages of the invention may be realized and attained by means of the instrumentalities and combinations particularly pointed out in the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated into and form a part of the specification, illustrate several embodiments of the present invention and, together with the description, serve to explain the principles of the invention. The drawings are only for the purpose of illustrating a preferred embodiment of the invention and are not to be construed as limiting the invention. In the drawings:

Fig. 1 is a schematic of the invention formed to the desired contour over a pre-formed mandrel; and

Fig. 2 is a schematic of the invention illustrating the shaping of multiple solar collectors by stacking several structured panels over a single mandrel.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

(BEST MODES FOR CARRYING OUT THE INVENTION)

A schematic depicting the sandwich-construction, structural panel 10 is shown in Fig. 1. The panel comprises a glass mirror 12 bonded to a front metal sheet 14, a core material 16, and a back metal sheet 18. A seal (not shown) positioned about the edges of the mirror and front sheet laminate prevents water from coming in contact with the silver surface of the glass mirror, and thereby prevents electrochemical corrosion and consequent loss of solar reflectivity. Also, by bonding the entire surface of the glass mirror to the front metal sheet the integrity of the mirror is maintained even if a portion of the mirror cracks or breaks. Thus, a broken solar collector can still operate and function safely.

In the preferred embodiment, the front 14 and back 18 metal sheet comprises carbon steel of similar or equal gauge, preferably 24 to 28 gauge. Carbon steel sheets with surface treatments such as electro-galvanizing are low cost, provide corrosion resistance, and enhance adhesion. The steel sheets are bonded to the core 16 with adhesive. Adhesive is applied to the front metal sheet 14 to bond the

glass mirror 12. The constructed panel 10 is then laid atop a mandrel 20 pre-shaped to a desired degree of curvature. The panel 10 and mandrel 20 are placed inside a sealed enclosure and a partial vacuum is applied. This process is generally known as vacuum bagging, and is used to provide uniform loads between the surface of the glass mirror 12 and the front metal sheet 14 while the adhesive is curing.

- 5 The partial vacuum also facilitates the shaping of the constructed panel 10 to the mandrel 20. Preferably, two part adhesive systems such as epoxy or acrylic, with working times of 10-90 minutes are used. The adhesive bonds between the front and back metal sheets and core "lock-in" the inverse curvature of the mandrel to give the desired shape to the solar collector.

10 The use of front and back metal sheets of similar material is important to the thermal stability of the panel, and therefore the maintenance of good optical characteristics over a range of ambient temperatures. The thermal expansion coefficient of steel (typically about $10.8 - 12.6 \times 10^{-6} \text{ m/m}^\circ\text{C}$ ($6-7 \times 10^{-6} \text{ in/in } ^\circ\text{F}$)) is a good match to glass ($5.4 - 12.6 \times 10^{-6} \text{ m/m}^\circ\text{C}$ ($3-7 \times 10^{-6} \text{ in/in } ^\circ\text{F}$), depending on composition). In contrast, the expansion coefficient of aluminum alloys (approximately $21.6 \times 10^{-6} \text{ m/m}^\circ\text{C}$ ($12 \times 10^{-6} \text{ in/in } ^\circ\text{F}$) and plastics ($45 - 54 \times 10^{-6} \text{ m/m}^\circ\text{C}$ ($25-30 \times 10^{-6} \text{ in/in } ^\circ\text{F}$)) are much higher than that of glass. The relatively close thermal-expansion-coefficient match of steel and glass minimizes thermally induced stresses and optical distortions. Second, the relatively high elastic modulus of steel, approximately 207,000 MPa ($30 \times 10^6 \text{ psi}$) vs. 69,000 MPa ($10 \times 10^6 \text{ psi}$) for glass, assures that the sandwich structure dominates the glass and maintains the shape as the temperature changes. Third, since the steel front and back sheets of the sandwich composite possess the same or similar thermal characteristics minimal changes in curvature occurs as the temperature changes.

15 The sandwich-type construction results in panels with excellent mechanical and optical properties. For the most part, the dimension of the constructed panels were approximately 0.5 x 0.6-m (20 x 24-inch). The radii-of-curvatures of the mandrels were 10.668, 13.208, and 15.748 meters (420, 520, and 620 inches). Optical characteristics on the resulting mirrored panels were evaluated by Video Scanning

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Optical Test (VSHOT) as described in Jones, S.A., Gruetzner, J.K., Houser, R.M., Edgar, R.M., Wendelin, T.J., 1997, "VSHOT Measurement Uncertainty and Experimental Sensitivity Study," Proceedings of the 32nd Intersociety Energy Conversion Engineering Conference, Honolulu, HI. Durability was determined by optical characterization both before and after environmental testing. Environmental testing was intended to evaluate structural and optical degradation from exposure to the environment. Silver corrosion and degradation was not an issue of interest. Tests ranged from exposure to elevated temperatures ($>50^{\circ}\text{C}$) to thermal cycling with high humidity.

Silvered mirror comprising 1 mm thick low-iron glass was obtained from Naugatuck Glass. It is important to minimize the handling of the mirror during every stage of fabrication. The silvered mirror is attached to the front metal sheet 14 to form a glass/steel laminate. The adhesive used to prepare the glass/steel laminate was 3M Y966 because it was least likely to corrode or otherwise disturb the mirror backings. Moreover, it lays down more easily without bubbles, and its liner peels back more trouble-free than other film adhesives. Also, a rubber sealing strip, preferably comprising solid EPDM, was positioned internal to the glass/steel laminate. Although the EPDM cannot be tinted white in a way that will not compromise its qualities white paint was applied. Also, the EPDM seal does not tend to accumulate heat the way metal a metal strip would. Pressure-sensitive acrylic tape, similar to the 3M Y966, was used to hold the rubber sealing strips in position. Bron tape BT 2979 was selected for low cost, strength, and ease of application.

Core materials comprising polystyrene, polyurethane, polyvinyl chloride (PVC) foams, and cardboard and aluminum honeycomb were evaluated. Core materials of polystyrene and urethane foams were found to be unstable at elevated temperatures ($>50^{\circ}\text{C}$). The preferred core used in the panels was 3/8" cell commercial grade, 1/4" thick aluminum core. The core used was commercial grade core made with .002" or .003" foil.

The metal sheets in the composite panels was 24 gauge electrogalvanized (Paintlok). The metal sheets should be free of dimples or "half-moon" dents because such defects could transfer distortion to the mirror. The adhesive chosen to bond the steel faces to the aluminum core was EA 150 HI-PRO, custom manufactured for Paneltec by Epoxy Formulations, Inc., of Englewood, Colorado. In some cases the panels were heated within the vacuum enclosure during the cure process to insure an overnight cure, and allowing for daily recycling of the mandrel and consequent increase in production efficiency. HYSOL 9394 was chosen for holding mounting pads to the backs of the panels. Its paste consistency helps hold the material from migrating from the bond-line.

Under some circumstances, it may be necessary to keep the panels from reaching extreme environmental temperatures. Such temperatures could possibly weaken the epoxy laminating adhesive and cause distortion in the curvature of the solar collector. To alleviate the heating problem, the backs of the composite panels were coated with Sherwin-Williams DTM (direct-to-metal) gloss white exterior latex, with suitable surface preparation to insure adhesion.

Industrial Applicability:

The invention is further illustrated by the following non-limiting examples.

Example 1

Two techniques have been employed to produce sandwich-type construction panels – vacuum bagging and foam-in-place. In vacuum bagging, the glass/steel laminate was laid mirror surface down onto a mandrel (as shown in Fig. 1). Adhesive was applied to the back of the glass/steel laminate and to one side of the back steel skin. A core material was placed between the steel skins in contact with the adhesive. The sandwich was then covered with and sealed inside a plastic sheet and a partial vacuum was applied. The partial vacuum results in a high and uniform clamping force that facilitates the curing process, and forces the steel and glass sheets to conform to the pre-determined shape of the mandrel.

Vacuums ranging from 381 to 584 mm of mercury (15 to 23 inches of mercury) were used. The inverse curvature of the mandrel is translated or locked into the composite panel.

5 A mirror segment was laid face down on the table, adhesive was pulled from the roll and stuck down at the far edge of the mirror, overhanging all edges, then pressed by hand to the mirror back, avoiding bubbles. The adhesive was cut from the roll and cut flush to the edges of the mirror with a razor knife. The side of the front sheet to be bonded to the mirror was wiped with denatured alcohol and a clean cloth to remove any grease that might interfere with lamination. A 1/2" wide strip of acrylic film tape was applied along all edges, for attachment of a rubber edge closure at the time of lamination.

10 A steel front sheet was laid down with two adjacent edges registering against fences to align the edges of the sheet to the edges of the mirror segments. Pressure was applied over the entire surface with j-rollers. After adhering the mirror to the front sheet an edge of the glass/mirror laminate was lifted and a support sheet of double-wall cardboard or other lightweight, thin material was inserted below the newly laminated face sheet. This provides additional stiffness in handling and a protective interlayer as the glass/sheet laminate was slid off its fixture and stacked onto a pallet to await boding to honeycomb.

15 Aluminum core was obtained as slices, rather than expanded sheets, to minimize freight costs. The core was dimensioned to provide material for 2 panels per slice, thus minimizing labor in expanding the core. Expansion was done on a 5' x 10' table with specially built frames to which the honeycomb was pinned. One frame was fixed to the table, the other frame was moveable. With the specially built frames several pieces of core could be pinned and expanded simultaneously. Following core expansion the cores were trimmed to final size.

20 Because of the prohibitive cost of mandrels and the long cure times required, we evaluated the affect of stacking on optical accuracy (see Fig. 2). The ability to manufacture optical elements from secondary mandrels is a key to reducing manufacturing costs. Stacks of material were arranged around the roll-coating machine. Laminated mirror and steel face sheets were on a scissors-lift table to allow them to be slid laterally with minimal flexure onto the 1 1/2" thick foam backing-board on which they ride

through the roll-coater. Laminating cradles were positioned near the out-feed of the roll-coater and cut-to-size plastic sheeting was laid over the cradles to be sealed over a stack of 8 panels and one mandrel so that a vacuum can be drawn.

The roll-coater was loaded with epoxy and a face sheet was fed through. Then the tape liner was pulled from the edges of the steel, exposing a 1/2" wide strip of acrylic adhesive. Pre-cut lengths of rubber edge closure were then laid down on the acrylic adhesive and the face sheet was placed on the laminating cradle, beginning the stacking procedure. A piece of honeycomb core was laid within the perimeter of rubber. A steel back sheet was fed through the roll-coater, inverted over the laminating cradle and placed down on the exposed honeycomb and rubber of the other half of the panel. The cradle has a "fence" at one side to facilitate alignment of the material. Material for 3 more panels was stacked, for a total of four composite panels atop a single, one-sided mandrel.

Alternatively, a total of 8 panels can be formed and shaped simultaneously by using a single, double-sided mandrel. Materials for four panels are prepared, arranged in proper sequence, and stacked. A double-sided mandrel is placed on top of the stacked materials. Then materials for four more panels are placed on the opposite side of the mandrel. In effect, both sides of a single mandrel are used, with materials for four panels each on the top and materials for four more panels beneath the mandrel. The stacked materials are then placed in a vacuum bag or chamber and a partial vacuum is applied.

At this point, insulating boards and a rack of infrared lights were fastened in place around the cradle. The stack was heated to 115°F and allowed to cure overnight. The enclosure was dismantled the following morning and the vacuum bag opened when the stack reached room temperature. The mounting pads were then attached to the back of the composite panels.

Example 2

The foam in place technique was performed exclusively with two-part urethane foams. Typically, a North Carolina Foam Industries, Inc. pour-in-place system (#811-91) was used. Typical foam density ranged from about 70.4 kg/m³ to 83.3 kg/m³ (4.4 to 5.2 lb/ft³) and was inversely proportional to cure temperature. With this technique, the glass/steel laminate was laid mirror surface down on the mandrel, as in the vacuum bag technique. The two-part urethane foam was then mixed, poured, and spread onto the back of the glass/steel laminate. The back steel sheet was then placed directly onto the foam. A frame spaced at a set distance from the mandrel secured the back steel sheet in place as the foam expanded and forced the foam to ooze from the sides of the sandwich. The force of the expanding foam forced the glass/steel laminate to conform to the mandrel. After the foam cured, the curvature of the mandrel was locked into the composite panel. The frame was then removed and the excess foam was trimmed from the edges.

The preceding examples can be repeated with similar success by substituting the generically or specifically described reactants and/or operating conditions of this invention for those used in the preceding examples.

Although the invention has been described in detail with particular reference to these preferred embodiments, other embodiments can achieve the same results. Variations and modifications of the present invention will be obvious to those skilled in the art and it is intended to cover in the appended claims all such modifications and equivalents. The entire disclosures of all references, applications, patents, and publications cited above are hereby incorporated by reference.

CLAIMS

What is claimed is:

- 5 1. A solar collector comprising:
 a glass mirror; and
 a composite panel, wherein a back of said mirror is affixed to a front surface of
said composite panel, said composite panel comprising a front sheet affixed to a surface of a core
material and a back sheet affixed to an opposite surface of said core material.
2. The solar collector of claim 1 further comprising a sealing strip positioned between said
glass mirror and said front surface of said composite panel.
3. The solar collector of claim 1 wherein said sealing strip comprises EPDM.
4. The solar collector of claim 1 wherein said glass mirror comprises a silvered backing.
5. The solar collector of claim 1 wherein said front sheet and back sheet comprise carbon
steel.
6. The solar collector of claim 5 wherein said carbon steel front sheet and carbon steel back
sheet comprise a gauge between approximately 24 and 28 gauge.
7. The solar collector of claim 1 wherein said core material comprises a honeycomb
25 structure.
8. The solar collector of claim 7 wherein said honeycomb core material comprises
aluminum.

9. The solar collector of claim 8 wherein said aluminum honeycomb core material comprises aluminum foil between approximately 0.015 and 0.004 inch foil.

10. The solar collector of claim 1 wherein said core material comprises foam selected from the group consisting of polystyrene, polyurethane, and polyvinyl chloride.

11. The solar collector of claim 1 wherein said core material comprises a cellulose based material.

12. A method of making a solar collector comprising the following steps:

- a) affixing a glass mirror to a front sheet to make a glass/sheet laminate;
- b) affixing the sheet side of the laminate to a surface of a core material;
- c) affixing a back sheet to an opposite surface of the core material to make a composite panel ; and
- d) shaping the composite panel to a specific curvature by curing the composite panel over a mandrel of approximately inverse curvature.

13. The method of claim 12 further comprising the step of positioning a sealing strip between the glass mirror and front sheet to minimize the accumulation of moisture between the glass mirror and front sheet.

14. The method of claim 12 further comprising the step of stacking a plurality of the composite panels atop a single, one-sided mandrel to allow simultaneous construction of solar collectors.

15. The method of claim 12 further comprising the step of applying a vacuum to the composite panel in contact with the mandrel.

16. The method of claim 14 further comprising the step of applying a vacuum to the composite panel in contact with the mandrel.

17. The method of claim 13 wherein the sealing strip comprises EPDM.

18. The method of claim 12 wherein the glass mirror comprises a silvered backing.

19. The method of claim 12 wherein the front sheet and back sheet comprise carbon steel.

20. The method of claim 19 wherein the carbon steel front sheet and carbon steel back sheet comprise a gauge between approximately 24 and 28 gauge.

21. The method of claim 12 wherein the core material comprises a honeycomb structure.

22. The method of claim 21 wherein the honeycomb structure comprises aluminum.

23. The method of claim 22 wherein said aluminum honeycomb structure comprises aluminum foil between approximately 0.015 and 0.004 inch foil.

24. The method of claim 12 further comprising the step of stacking a plurality of the composite panels above and below a single, double-sided mandrel to allow simultaneous construction of solar collectors.

25. A method of making a solar collector comprising the following steps:

- a) affixing a glass mirror to a front sheet to make a glass/sheet laminate;
- b) placing the glass/sheet laminate mirror side down over a mandrel of
5 specific curvature;
- c) applying a coating expandable foam on the sheet side of the laminate;
- d) positioning a back sheet in a frame such that as the foam expands the
foam comes in contact with a surface of the back sheet and forces the composite panel to adopt the
inverse shape of the mandrel; and
- e) removing the frame from the back sheet and the composite panel from
10 the mandrel.

26. The method of claim 25 wherein said expandable foam is selected from the group
consisting of polystyrene, polyurethane, and polyvinyl chloride.

27. The method of claim 25 wherein the glass mirror comprises a silvered backing.

28. The method of claim 25 wherein the front sheet and back sheet comprise carbon steel.

29. The method of claim 25 wherein the carbon steel front sheet and carbon steel back sheet
comprise a gauge between approximately 24 and 28 gauge.

SOLAR REFLECTION PANELS

ABSTRACT OF THE DISCLOSURE

A solar collector comprising a glass mirror, and a composite panel, wherein the back of the mirror is affixed to a front surface of the composite panel. The composite panel comprises a front sheet affixed to a surface of a core material, preferably a core material comprising a honeycomb structure, and a back sheet affixed to an opposite surface of the core material. The invention may further comprise a sealing strip, preferably comprising EPDM, positioned between the glass mirror and the front surface of the composite panel. The invention also is of methods of making such solar collectors.

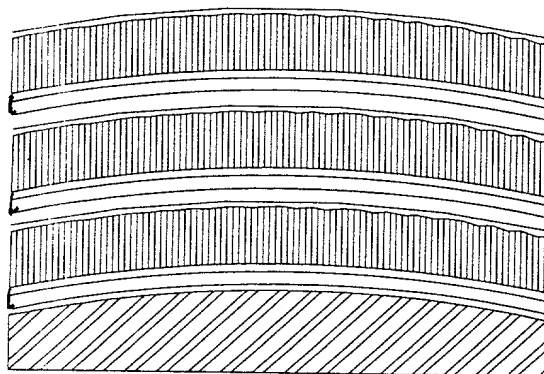
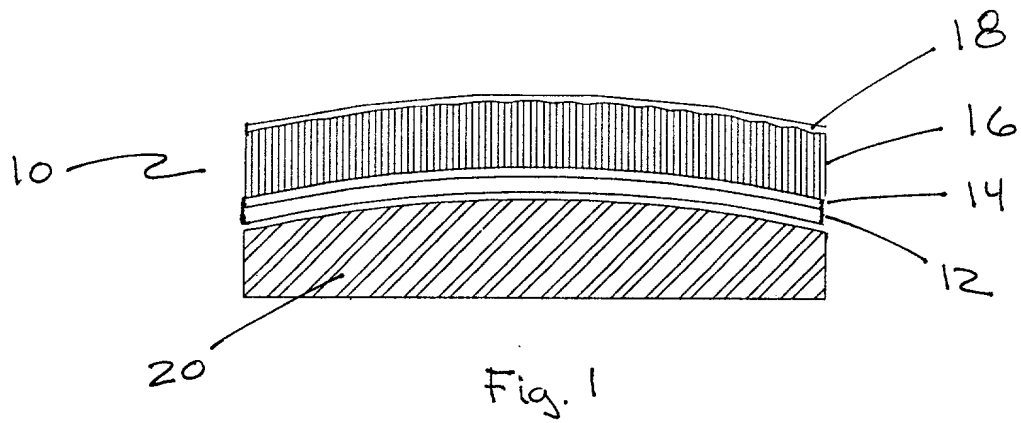


Fig. 2

Practitioner's Docket No. SD-6358**PATENT****COMBINED DECLARATION AND POWER OF ATTORNEY**(ORIGINAL, DESIGN, NATIONAL STAGE OF PCT, SUPPLEMENTAL, DIVISIONAL,
CONTINUATION, OR C-I-P)

As a below named inventor, I hereby declare that:

TYPE OF DECLARATION

This declaration is of the following type:

(check one applicable item below)

☒ original.☐ design.

NOTE: With the exception of a supplemental oath or declaration submitted in a reissue, a supplemental oath or declaration is not treated as an amendment under 37 CFR 1.312 (Amendments after allowance). M.P.E.P. § 714.16, 7th Edition.

☐ supplemental.

NOTE: If the declaration is for an International Application being filed as a divisional, continuation or continuation-in-part application, do not check next item; check appropriate one of last three items.

☐ national stage of PCT.

NOTE: If one of the following 3 items apply, then complete and also attach ADDED PAGES FOR DIVISIONAL, CONTINUATION OR C-I-P.

NOTE: See 37 C.F.R. § 1.63(d) (continued prosecution application) for use of a prior nonprovisional application declaration in the continuation or divisional application being filed on behalf of the same or fewer of the inventors named in the prior application.

☐ divisional.☐ continuation.

NOTE: Where an application discloses and claims subject matter not disclosed in the prior application, or a continuation or divisional application names an inventor not named in the prior application, a continuation-in-part application must be filed under 37 C.F.R. § 1.53(b) (application filing requirements — nonprovisional application).

☐ continuation-in-part (C-I-P).**INVENTORSHIP IDENTIFICATION**

WARNING: If the inventors are each not the inventors of all the claims, an explanation of the facts, including the ownership of all the claims at the time the last claimed invention was made, should be submitted.

My residence, post office address and citizenship are as stated below, next to my name. I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter that is claimed, and for which a patent is sought on the invention entitled:

TITLE OF INVENTIONSOLAR REFLECTION PANELS

SPECIFICATION IDENTIFICATION

the specification of which:

(complete (a), (b), or (c))

(a) ☒ is attached hereto.

NOTE: "The following combinations of information supplied in an oath or declaration filed on the application filing date with a specification are acceptable as minimums for identifying a specification and compliance with any one of the items below will be accepted as complying with the identification requirement of 37 CFR 1.63:

"(1) name of inventor(s), and reference to an attached specification which is both attached to the oath or declaration at the time of execution and submitted with the oath or declaration on filing;

"(2) name of inventor(s), and attorney docket number which was on the specification as filed;
or

"(3) name of inventor(s), and title which was on the specification as filed."

Notice of July 13, 1995 (1177 O.G. 60).

(b) ☐ was filed on _____, as ☐ Serial No. 0 / _____
or ☐ _____
and was amended on _____ (if applicable).

NOTE: Amendments filed after the original papers are deposited with the PTO that contain new matter are not accorded a filing date by being referred to in the declaration. Accordingly, the amendments involved are those filed with the application papers or, in the case of a supplemental declaration, are those amendments claiming matter not encompassed in the original statement of invention or claims. See 37 C.F.R. § 1.67.

NOTE: "The following combinations of information supplied in an oath or declaration filed after the filing date are acceptable as minimums for identifying a specification and compliance with any one of the items below will be accepted as complying with the identification requirement of 37 CFR 1.63:

"(A) application number (consisting of the series code and the serial number, e.g., 08/123,456);

"(B) serial number and filing date;

"(C) attorney docket number which was on the specification as filed;

"(D) title which was on the specification as filed and reference to an attached specification which is both attached to the oath or declaration at the time of execution and submitted with the oath or declaration; or

"(E) title which was on the specification as filed and accompanied by a cover letter accurately identifying the application for which it was intended by either the application number (consisting of the series code and the serial number, e.g., 08/123,456), or serial number and filing date. Absent any statement(s) to the contrary, it will be presumed that the application filed in the PTO is the application which the inventor(s) executed by signing the oath or declaration."

M.P.E.P. § 601.01(a), 7th Ed.

(c) ☐ was described and claimed in PCT International Application No. _____, filed on _____ and as amended under PCT Article 19 on _____ (if any).

(Declaration and Power of Attorney [1-1]—page 2 of 7)

SUPPLEMENTAL DECLARATION (37 C.F.R. § 1.67(b))

(complete the following where a supplemental declaration is being submitted)

- ☐ I hereby declare that the subject matter of the
- ☐ attached amendment
 - ☐ amendment filed on _____

was part of my/our invention and was invented before the filing date of the original application, above-identified, for such invention.

ACKNOWLEDGEMENT OF REVIEW OF PAPERS AND DUTY OF CANDOR

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information, which is material to patentability as defined in 37, Code of Federal Regulations, § 1.56,

(also check the following items, if desired)

- ☒ and which is material to the examination of this application, namely, information where there is a substantial likelihood that a reasonable Examiner would consider it important in deciding whether to allow the application to issue as a patent, and
- ☐ in compliance with this duty, there is attached an information disclosure statement, in accordance with 37 C.F.R. § 1.98.

PRIORITY CLAIM (35 U.S.C. §§ 119(a)-(d))

NOTE: "The claim to priority need be in no special form and may be made by the attorney or agent if the foreign application is referred to in the oath or declaration as required by § 1.63. The claim for priority and the certified copy of the foreign application specified in 35 U.S.C. 119(b) must be filed in the case of an interference (§ 1.630), when necessary to overcome the date of a reference relied upon by the examiner, when specifically required by the examiner, and in all other situations, before the patent is granted. If the claim for priority or the certified copy of the foreign application is filed after the date the issue fee is paid, it must be accompanied by a petition requesting entry and by the fee set forth in § 1.17(i). If the certified copy is not in the English language, a translation need not be filed except in the case of interference; or when necessary to overcome the date of a reference relied upon by the examiner; or when specifically required by the examiner, in which event an English language translation must be filed together with a statement that the translation of the certified copy is accurate." 37 C.F.R. § 1.55(a).

I hereby claim foreign priority benefits under Title 35, United States Code, §§ 119(a)-(d) of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed.

(complete (d) or (e))

- (d) ☒ no such applications have been filed.
- (e) ☐ such applications have been filed as follows.

NOTE: Where item (c) is entered above and the International Application which designated the U.S. itself claimed priority check item (e), enter the details below and make the priority claim.

**PRIOR FOREIGN/PCT APPLICATION(S) FILED WITHIN 12 MONTHS
(6 MONTHS FOR DESIGN) PRIOR TO THIS APPLICATION
AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. § 119(a)-(d)**

COUNTRY (OR INDICATE IF PCT)	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 37 USC 119
			<input type="checkbox"/> YES NO <input type="checkbox"/>
			<input type="checkbox"/> YES NO <input type="checkbox"/>
			<input type="checkbox"/> YES NO <input type="checkbox"/>
			<input type="checkbox"/> YES NO <input type="checkbox"/>
			<input type="checkbox"/> YES NO <input type="checkbox"/>

CLAIM FOR BENEFIT OF PRIOR U.S. PROVISIONAL APPLICATION(S)
(34 U.S.C. § 119(e))

I hereby claim the benefit under Title 35, United States Code, § 119(e) of any United States provisional application(s) listed below:

PROVISIONAL APPLICATION NUMBER

FILING DATE

____ / _____
 ____ / _____
 ____ / _____

CLAIM FOR BENEFIT OF EARLIER US/PCT APPLICATION(S)
UNDER 35 U.S.C. § 120

- ☐ The claim for the benefit of any such applications are set forth in the attached ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR CONTINUATION-IN-PART (C-I-P) APPLICATION.

**ALL FOREIGN APPLICATION(S), IF ANY, FILED MORE THAN 12 MONTHS
(6 MONTHS FOR DESIGN) PRIOR TO THIS U.S. APPLICATION**

NOTE: If the application filed more than 12 months from the filing date of this application is a PCT filing forming the basis for this application entering the United States as (1) the national stage, or (2) a continuation, divisional, or continuation-in-part, then also complete ADDED PAGES TO COMBINED DECLARATION AND POWER OF ATTORNEY FOR DIVISIONAL, CONTINUATION OR C-I-P APPLICATION for benefit of the prior U.S. or PCT application(s) under 35 U.S.C. § 120.

POWER OF ATTORNEY

I hereby appoint the following practitioner(s) to prosecute this application and transact all business in the Patent and Trademark Office connected therewith.

(list name and registration number)

Jeffrey D. Myers, Reg. No. 35,964

(check the following item, if applicable)

- ☒ I hereby appoint the practitioner(s) associated with the Customer Number provided below to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith.
- ☐ Attached, as part of this declaration and power of attorney, is the authorization of the above-named practitioner(s) to accept and follow instructions from my representative(s).

NOTE: "Special care should be taken in continuation or divisional applications to ensure that any change of correspondence address in a prior application is reflected in the continuation or divisional application. For example, where a copy of the oath or declaration from the prior application is submitted for a continuation or divisional application filed under 37 CFR 1.53(b) and the copy of the oath or declaration from the prior application designates an old correspondence address, the Office may not recognize, in the continuation or divisional application, the change of correspondence address made during the prosecution of the prior application. Applicant is required to identify the change of correspondence address in the continuation or divisional application to ensure that communications from the Office are mailed to the current correspondence address. 37 CFR 1.63(d)(4)." § 601.03, M.P.E.P., 7th Edition.

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office: (505) 998-1500

(complete the following if applicable)

Since this filing is a ☐ continuation ☐ divisional there is attached hereto a Change of Correspondence Address so that there will be no question as to where the PTO should direct all correspondence.

(check proper box(es) for any of the following added page(s)
that form a part of this declaration)

- ☐ **Signature** for fourth and subsequent joint inventors. Number of pages added _____

* * *

- ☐ **Signature** by administrator(trix), executor(trix) or legal representative for deceased or incapacitated inventor. Number of pages added _____

* * *

- ☐ **Signature** for inventor who refuses to sign or cannot be reached by person authorized under 37 CFR 1.47. Number of pages added _____

* * *

- ☐ Added page for **signature** by one joint inventor on behalf of deceased inventor(s) where legal representative cannot be appointed in time. (37 CFR 1.47)

* * *

- ☐ Added pages to combined declaration and power of attorney for divisional, continuation, or continuation-in-part (C-I-P) application.

☐ Number of pages added _____

* * *

- ☐ Authorization of practitioner(s) to accept and follow instructions from representative.

* * *

(if no further pages form a part of this Declaration,
then end this Declaration with this page and check the following item)

- ☒ This declaration ends with this page.

DECLARATION

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

SIGNATURE(S)

NOTE: Carefully indicate the family (or last) name, as it should appear on the filing receipt and all other documents.

NOTE: Each inventor must be identified by full name, including the family name, and at least one given name without abbreviation together with any other given name or initial, and by his/her residence, post office address and country of citizenship. 37 CFR § 1.63(a)(3).

NOTE: Inventors may execute separate declarations/oaths provided each declaration/oath sets forth all the inventors. Section 1.63(a)(3) requires that a declaration/oath, inter alia, identify each inventor and prohibits the execution of separate declarations/oaths which each sets forth only the name of the executing inventor. 62 Fed. Reg. 53,131, 53,142, October 10, 1997,

Full name of sole or first inventor

<u>RICHARD</u>	<u>B.</u>	<u>DIVER, JR.</u>
(GIVEN NAME)	(MIDDLE INITIAL OR NAME)	FAMILY (OR LAST NAME)

Inventor's signature _____

Date _____ Country of Citizenship US

Residence Albuquerque, New Mexico

Post Office Address _____

Full name of second joint inventor, if any

<u>JAMES</u>	<u>W.</u>	<u>GROSSMAN</u>
(GIVEN NAME)	(MIDDLE INITIAL OR NAME)	FAMILY (OR LAST NAME)

Inventor's signature _____

Date _____ Country of Citizenship _____

Residence Albuquerque, New Mexico

Post Office Address _____

Full name of third joint inventor, if any

<u>MICHAEL</u>		<u>RESHETNIK</u>
(GIVEN NAME)	(MIDDLE INITIAL OR NAME)	FAMILY (OR LAST NAME)

Inventor's signature _____

Date _____ Country of Citizenship _____

Residence Lafayette, Colorado

Post Office Address _____